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O&M Newsletter

A monthly newsletter for wastewater discharge licensees, treatment facility operators and associated persons

Energy in Wastewater Treatment Facilities

In this, our last article in our energy series, we talk about Demand Side Management. That is, things you can do to reduce your energy costs by improving efficiency and doing more with less. If you have any ideas for serial articles like this or any other topics you would like to see covered, please send them along to me at dick.darling@state.me.us.

Where to Begin

The first step to an effective energy management program for your facility is to understand where your energy dollars go- Learn how and when each piece of equipment uses energy. How much energy goes to pumping, aeration, or lighting? What portion of the bill is for electrical energy consumption (kWh) versus peak power demand (kW)? Are demand charges ratcheted (monthly charges linked to the highest power draw over the preceding year)? Is a power factor penalty, or kVA charge, levied? The answers to these questions tell you where to look for both energy and cost savings.

Conduct an Energy Survey

Energy surveys can vary in complexity, but a complete energy audit should answer these questions.

* ***How much electricity is being used and at what time of day***? Can the use be reduced through changed operations?

* ***How much is the utility charging for power*** and can it be reduced by using a different rate schedule?

* ***How efficient is the equipment*** and is it worthwhile to improve the efficiency?

* ***Can a change in the process result in improved energy use?***

The survey report should include recommendations for actions that will lead to energy and cost savings and should indicate the cost savings for each recommended action. A survey can be conducted by facility staff, if they have the time, or by contracting with a professional energy consultant.

There are three general levels to energy surveys. Ideally, you would want to start with the most basic survey and as opportunities are identified more thorough levels of analysis can be undertaken. If a consultant is used this may not be practical. However, it is advised that the facility at least conduct a desktop survey of their billing data before hiring a consultant.

A **desktop survey** principally involves an analysis of billing data. Understand your current electricity use (kWh) and your peak demand (kW). Calculate the energy cost of the facility in an understandable unit such as dollars per thousand gallons or per million gallons treated. This will establish a benchmark of energy use at the facility and can potentially identify some easy areas for energy reduction and cost savings. The facility staff can conduct this survey.

A **walkthrough survey** requires a brief inspection of the facility, all the equipment and methods of operation. Billing data is also analyzed. By comparing billing data to the daily operations opportunities for improving operations and thereby reducing energy and costs may be found. The rate at which energy is used will vary throughout the day, depending upon factors such as demand from the influent flow and biochemical oxygen demand (BOD) loading. Plot daily electrical load as a function of time for different plant loading conditions. Note which large equipment can be operated off-peak. Examine all available rate schedules to determine which can provide the lowest cost in conjunction with appropriate operational changes. Many facilities have the experience to perform this type of survey but do not have the time. Many professional energy consultants are available to help.

A **detailed survey** requires an in-depth inspection and analysis of the facility. In addition to analyzing billing data and operations, all energy-consuming systems are evaluated, including motors, pumps and lighting. In most cases a professional energy firm is contracted

Reduce Peak Demand

For many facilities, a significant portion of their electric bill is for peak power demand. To help reduce the demand, look for opportunities to shift large electrical loads to off-peak time periods. For example, some plants can use system storage to ride out periods of highest load rather than operating pumps, or shifting high energy using operations, such as solids processing, to off-peak. Some facilities use alternative power, such as a generator, during the peak hours. Also, avoid running large intermittent pumps when operating the main pumps.

Equipment that must run during the peak period should be as efficient as possible. This would include the motors and pumps for main pump station, RAS and aeration system. Calculate the demand and monthly energy consumption for the largest motors in your plant. You may be surprised at the results. A 25 hp motor may cost over $1,400 per month if run continuously. An increase in equipment or system efficiency may be cost effective. During on-peak periods, avoid using large equipment simultaneously: two 25 kW pumps that run only two hours each day can contribute 50 kW to the demand if run at the same time.

Improve Power Factor

Power factor is the relationship (phase) of current and voltage in AC electrical distribution systems and is a measure of how efficiently electrical power is being used. A high power factor indicates efficient use of the electrical energy while a low power factor shows poor energy use. Motors and other inductive equipment require two types electric power. One type is **Working**

Power, measured by the kilowatt (kW). This is what actually powers the equipment and does the work. Secondly, inductive motors need magnetizing power to operate. The measurement of the magnetizing power, or **Reactive Power**, is the kilovolt-ampere Reactive (kVAr). **Reactive Power** does no work. The Working Power and the Reactive Power together make up **Apparent Power**, which is measured in Kilovolt-ampere (kVA). Power Factor is determined by dividing the Working Power by the Apparent Power (kW/kVA).

Under ideal conditions current and voltage are "in phase" and the power factor is 100%. If inductive loads (e.g. motors, transformers, and ballasts) are present, power factors less than 100%, typically 80 to 90% can occur. The more inductive equipment a facility has the more reactive power (does no work) is required, and power factor decreases. Motors that run less than fully loaded also contribute to low power factor and waste energy because motor efficiency drops off below full load.

The power distribution system in buildings can be overloaded by excess (useless) current. Facilities that use a lot of power, such as treatment facilities, should consider correcting power factor to restore the kVA capacity of overloaded feeders within the building, and of course, to reduce the amount of your penalty, if you have one. If a charge is not assessed, the utility company builds this expense into its rate schedule. All customers share the burden. Under the system where specific charges are assessed for low power factor, consumers do have the opportunity to reduce their power bills by improving their power factors.
Analyzing your utility bills will usually reveal if you have a power factor problem. Even if the utility does not bill directly for power factor, a low power factor can raise your kWh and demand billing. This is because of real power is wasted by reactive power needs.

Possible Improvements

The two main causes for low power factor are non-working reactive power (kVAr) of inductive motors, and inefficient motors. Some strategies for improving your power factor are:

* ***Correct poor electrical contacts.*** Poor contacts contribute to electrical inefficiency and are the most cost effective to correct.

* ***Survey for insulation and undersized conductors.***

* ***Use the highest speed motor that an application can accommodate.*** Two pole (3600 rpm) motors have the highest power factor. Power factor decrease as the number of poles increase.

* ***Size motors as close as possible to the horsepower demands of the load.*** Motor efficiency decreases as the load decreases. Sometimes a smaller motor can be installed to handle lower loads or perhaps the motor should be resized (see Attachment G-resizing pumps). Also, older motors are less efficient than the motors available today.

* ***Determine your facilities power factor*** and evaluate installing power factor correction capacitors. Capacitors are devices that store an electrical charge. In the case of inductive motors, they can store the needed reactive power to operate the motors. Capacitors are sized by the kVAr needed and cost about $30 per kVAr.

The greater your power factor the less reactive loading you will have and therefore less energy costs.

Energy Efficiency Opportunities

Below are some general areas that may improve energy use at wastewater treatment facilities and is included as information only. An energy assessment will determine which improvements are cost-effective and beneficial to a facility.

Aeration

Install automatic DO control on aerators
Variable Speed Drives (VSDs) on mechanical aerators or aeration blowers.
Convert to diffused air aeration.
Convert from coarse to fine bubble aeration.
Reduce air pressure when possible.
Consider anaerobic and deep well treatment technology.

Pumping - General

Install VSDs on pumps with long run hours and that are throttled or have Bypasses.
Run pumps in parallel.
Reduce pressures where possible.
Install improved efficiency motors/pumps/valves.
Downsize where oversized.

Lift Stations

Install VSDs on pumps.
Install improved pump controls.
Install improved efficiency pumps/motors/valves.
Vary well levels to reduce loads, especially during peaks.

Sludge Handling and Disposal

Install VSDs on sludge pumps.
Improve dewatering before incineration.
Install VSDs on incinerator fans.
Consider land disposal or pelletizing vs incineration.

Reducing Peak Load

Consider self-generation at system peaks.
Schedule pumping during lower cost periods.
Identify loads that can be reduced or interrupted.
Consider more storage.

Lighting

Turn them off, if not necessary.
Remove a lamp or two, particularly near windows.
Replace old or inefficient lamps with energy efficient models.
Replace old fixture with energy efficient models.
Install automatic light sensor switches.

For Practice

1. The sensivity of an instrument used to perform a laboratory test is a measure of
   a. The accuracy of the average measurement
   b. The precision of the median measurement
   c. The accuracy of the smallest or largest measurement made
   d. The values of all measurements repeatedly.

2. The basic unit of electrical potential is:
   a. the watt
   b. the ohm
   c. the volt
   c. the ampere

3 If water in a channel is passing a given point at 1.5 cubic feet per second, how many gallons of water will pass that point in 3 minutes?
   a. 2,025 gallons
   b. 1,865 gallons
   c. 270 gallons
   d. 33.75 gallons

4. What is the name of one chemical that can be added to a bacteriological sample to remove residual chlorine from the sample?
   a. Sodium hydroxide
   b. Sodium thiosulphate
   c. Sodium chloride
   d. Sodium hexametaphosphate

Approved Training

October 17, 2002 in Portland, ME – Pumping Hydraulics for Water & Wastewater Operators – Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
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October 22, 2002 in New Gloucester, ME – Wastewater Planning, Operation & Maintenance – Sponsored by MRWA (207) 729-6569 – Approved for 6 hours.
*****

October 23, 2002 in Augusta, ME - Wastewater Treatment Certification Review Class IV & V – Sponsored by MWRA, (207) 729-6569 – Approved for 6 hours.
*****

October 24, 2002 in Old Orchard Beach, ME – QA/QC for Wastewater Laboratories – Sponsored by MWRA, (207) 729-6569 – Approved for 5 hours.
*****

October 29, 2002 in East Vassalboro, ME - Backflow Prevention Devices: Troubleshooting & Repairs – Sponsored by MWRA, (207) 729-6569 – Approved for 3.5 hours.
*****

October 29, 2002 in Norway, ME - Effective Safety & Health Programming in the Utilities Industry: A MUST Program – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.
*****

October 29&30, November 6&7, 2002 in Rockland, ME - NPDES Laboratory Procedures (4) day course – Sponsored by MWRA, (207) 729-6569 – Approved for 16 hours.
*****

October 30, 2002 in Presque Isle, ME - Wastewater Treatment Certification Review Class IV & V – Sponsored by MWRA, (207) 729-6569 – Approved for 6 hours.
*****

October 30, 2002 in Topsham, ME - Backflow Prevention Devices: Troubleshooting & Repairs – Sponsored by MWRA, (207) 729-6569 – Approved for 3.5 hours.
*****

October 30, 2002 in Livermore Falls, ME - Effective Safety & Health Programming in the Utilities Industry: A MUST Program – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.

October 31, 2002 in Augusta, ME - Wastewater Treatment Certification Review Class I - III – Sponsored by MWRA, (207) 729-6569 – Approved for 6 hours.
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October 31, 2002 in York, ME - Backflow Prevention Devices: Troubleshooting & Repairs – Sponsored by MWRA, (207) 729-6569 – Approved for 3.5 hours.
*****
November 4,5 & 6, 2002 in Brewer, ME – Wastewater Collection System & NEWEA Voluntary Certification Exam – Sponsored by NEIWPCC, (978) 323-7929 – Approved for 13 hours.
*****
November 5, 2002 in Presque Isle, ME - Wastewater Treatment Certification Review Class I - III – Sponsored by MWRA, (207) 729-6569 – Approved for 6 hours.
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November 6, 2002 in Bangor, ME - Backflow Prevention Devices: Troubleshooting & Repairs – Sponsored by MWRA, (207) 729-6569 – Approved for 3.5 hours.
November 7, 2002 in Houlton, ME - Backflow Prevention Devices: Troubleshooting & Repairs – Sponsored by MWRA, (207) 729-6569 – Approved for 3.5 hours.
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November 16, 2002 in Mexico, ME - Confined Space Entry: Alternate Procedures c5, Reclassification c7 & Rescue and Emergency Services - A MUST Program – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.
*****
November 19, 2002 in Ellsworth, ME – QA/QC for your Laboratory Equipment & Establishing a Laboratory QA/QC Program - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
November 21, 2002 in Augusta, ME – Biological Nutrient Removal – Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
December 3 & 4, 2002 in Freeport, ME - MRWA Annual Conference – Sponsored by MWRA, (207) 729-6569 – Approved for TBA hours.
*****
December 4, 2002 in Livermore Falls - ME Polymer Sealants for use in Water & Wastewater Facilities along with ORP & pH Consideration - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
December 10, 2002 in North Vassalboro - Advanced use of Databases for Water & Wastewater Operators - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.

Answers to *For Practice:*

1. c. The sensitivity of an instrument is that instrument's ability to measure a large or small quantity. For example, a pipette calibrated to 1/100 of a ml is more sensitive than a pipette calibrated to 1/10 of a ml.

2. c The volt is the unit used to express electrical potential.

3. a. 1.5 CFS X 7.5 gallons/cubic foot X 60 seconds/minute X 3.0 minutes = 2,025 gallons.

4. b Sodium thiosulphate is the dechlorination agent normally used to remove residual chlorine from bacteriological samples.